QAPP Worksheet No. 17. Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Prior to (or concurrently with) sediment sampling, a SPI survey will be conducted. A SPI survey was conducted in the LPRSA in 2005 (Germano & Associates 2005), which provided useful information about benthic invertebrates and sediment conditions in the LPRSA. The 2005 dataset will be refreshed to reflect current conditions. The SPI survey will reoccupy locations from the 2005 survey, as well as the 78 sampling locations for invertebrate abundance over depth.

For the purpose of evaluating vertical locations of benthic organisms within the upper 15 cm of sediment, abundance and biomass samples will be collected from the mouth of the river at Newark Bay (RM 0) to RM 16.[1] Sediment sampling will follow a stratified random pattern, with sampling locations stratified by salinity and sediment grain size.

Salinity zones provided in the BERA for benthic invertebrates (Windward [in prep]) were used to stratify sampling. These zones include the following:

- Upper estuary zone (RM 0 to RM 4)
- Transition zone (RM 4 to RM 13)
- Tidal freshwater zone (RM 13 to RM 17.4)

Sediment grain size (which was characterized by Aqua Survey (2006)) was used to further stratify sampling locations within each of these salinity zones. Sediment was characterized as either fine (which included silt and silt/sand combinations) or coarse (which included sand, coarse sand, and cobble).

Using GIS, spatial polygons were created to define the extent of coarse or fine sediments within each salinity zone, and 13 abundance sampling locations were randomly placed within each polygon (i.e., for 78 locations total site wide) (Figure 2). Actual sampling locations may vary somewhat from the proposed locations due to inaccuracies in GPS readings or inability to collect an acceptable grab sample at the designated location (e.g., if sediment is too coarse to collect an adequate grab sample as defined in the Benthic QAPP). The number of grab locations for abundance by depth calculations was selected to ensure statistical power.[2] A subset of the samples collected to determine abundance will be used to determine the biomass of the benthic organisms in each depth horizon. Approximately 30% of the abundance samples will be used with the samples evenly split between each of the three salinity zones. Within each salinity zone the biomass samples will be evenly split between the two grain size strata.

[1] Sampling upstream of RM 16 is not feasible with a powered van Veen grab due to the coarseness of the substrate and shallowness for boat access in that area.

[2] Assumes that comparisons will be made using non-parametric, one-tailed, Wilcoxin-signed rank test of paired abundance data.

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The number of tissue chemistry sampling locations is based on the estimated biomass collected during the fall 2009 sampling effort (Windward 2014). Biomass was estimated as follows:

- Per-individual mass values were calculated from or directly available in the literature (CBBMP 2014; Whiles and Goldowitz 2005; Barbone et al. 2007; Bloom et al. 1972; Douce 1976; Ricciardi and Bourget 1998; Smit et al. 1993; Sapkarev 1967; Newton 2013).
- The abundance of individuals collected from the LPRSA between a depth of 0 and 15 cm in fall 2009 was converted directly to a wet weight of biomass using the per-individual biomass values. This conversion was done for each sediment grab.
- Because the fall 2009 samples were collected at a sediment depth of greater than 15 cm, the estimated per-grab biomass was scaled down, assuming that 75% of the total biomass at a depth of greater than 15 cm was present within the majority-biomass depth of 0 to 15 cm.
- The average scaled biomass-per-grab estimate was then used to estimate the number of samples required to collect sufficient tissue for chemical analyses, conservatively assuming that 20 g ww will be required (rather than 14 g ww [12 g ww required for analysis and 2 g ww for losses during analysis]). The estimated number of samples needed to collect adequate biomass is highly uncertain; the true number of locations will be adjusted (either up or down) in order to collect adequate biomass. By determining biomass as part of the first phase of sampling (i.e., prior to collecting samples for tissue chemistry), a better estimate of the number of samples will be possible after the completion of vertical depth interval sampling. If significant effort beyond the estimated sample count is expended to collect tissue samples, but the target mass cannot be obtained, sampling will stop and fewer tissue analyses will be run (Worksheet No. 10).

Taxonomy of the benthic invertebrate community will be characterized using a subset of the benthic tissue concentration sampling locations, which were placed evenly across the salinity gradient to best characterize invertebrate community structures along that gradient (Figure 3). Locations along the LPRSA salinity gradient were selected from the randomly selected grab locations for tissue chemistry; the four most proximate locations (to each other) were grouped to form each taxonomic composite sampling area.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

The rationale and description of the sampling design is provided in the above section entitled “Describe and provide a rationale for choosing the sampling approach” and in the section entitled “Where, when, and how should the data be collected/generated?” in Worksheet No.11.

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Sampling protocols will be consistent with those used for the SQT and sediment-only samples collected from the LPRSA in 2009. The sampling protocols will be implemented, as practicable, for the field sampling effort and laboratory testing, as described in further detail in Worksheet No. 21, Attachment M of the Benthic QAPP (Windward 2009), and applicable revisions made to Attachment M for this QAPP Addendum No. 6 (Attachment M). Surface sediment (0 to 15 cm) will be collected in a consistent, repeatable manner with a stainless steel, 0.2-m^2 hydraulic power grab or similar van Veen grab sampler, or if necessary, by hand with a large, clean, and dedicated stainless steel serving spoon; surface sediment must also meet the acceptability criteria (described in Revision 1 to Attachment D of the Benthic QAPP). A stainless steel tube (4-in. diameter by 8-in. height) will be used to collect subsamples from accepted sediment grabs. Any large non-sediment items, such as rocks, shells, or wood chips, will be removed prior to processing for abundance and biomass determinations, tissue chemistry and taxonomy; the surfaces of these items will be scraped to remove any invertebrates, which will be included with the rest of the sample..

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